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HPAS (Main)—2017

CIVIL ENGINEERING

Paper I

Time : 3 Hours

Maximum Marks : 100

Note :— (i) Question No. 1 is compulsory. Attempt any four questions from the remaining questions in all. Five questions are to be attempted.

(ii) Use of I.S. Codes of Practice and Steel Section Handbook is permitted.

(iii) Assume suitable missing Data, if any.

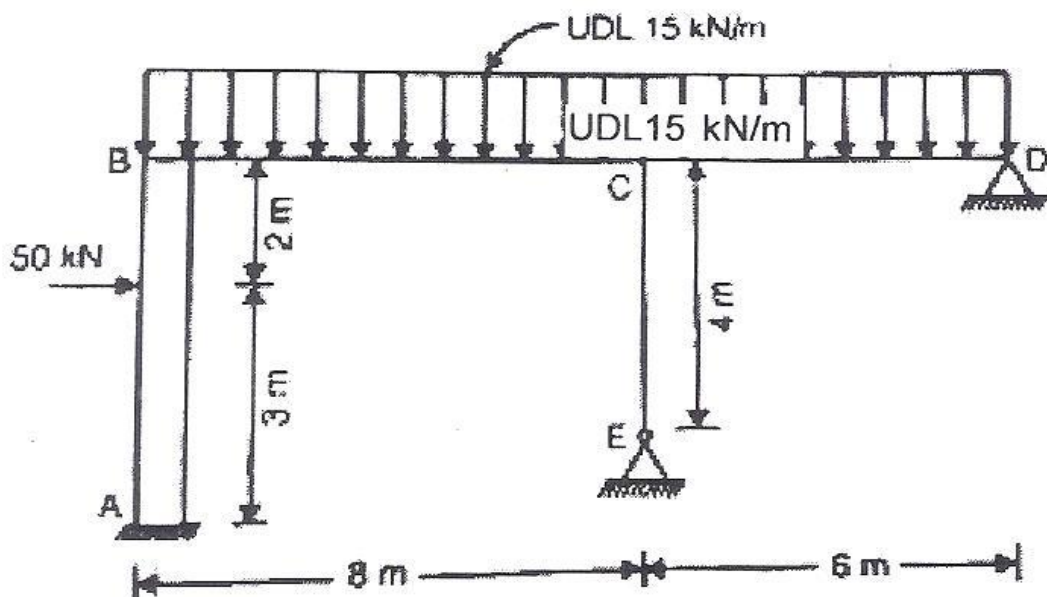
1. (a) Estimate the quantities of cement, fine aggregate and coarse aggregate per cubic meter of concrete if the void ratio in cement is 62%, fine aggregate is 41% and coarse aggregate is 45%. The material properties are as follows :
- Mix is 1 : 2 : 4 with a w/c of 0.55, one bag

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of cement contain 50 kg of cement and its density is 1440 kg/m^3 . The density of fine aggregate is 1700 kg/m^3 and coarse aggregate is 1600 kg/m^3 respectively. One bag of cement is equal to 34.7 litres. 10

- (b) Describe with sketches the construction of a 30+30 cm and 40+40 cm Brick column in English and Flemish Bonds. 10

2. Analyze the rigid frame shown in the below figure by moment distribution method, taking flexural rigidity EI to be uniform for all members. 20



3. ISMB 450 is used as a propped cantilever beam of span 12 m. Assuming $\sigma_y = 250$ MPa, determine the factored uniformly distributed load q_u the beam can carry including self weight, if the load is to be applied over the entire span. 20

The properties of ISMB 450 are as follows :

Weight/Metre : 72.4 kg

Area of cross-section : 9227 mm²

Width of flange : 150 mm

Thickness of flange : 17.4 mm

I_{xx} = 3.039×10^8 mm⁴

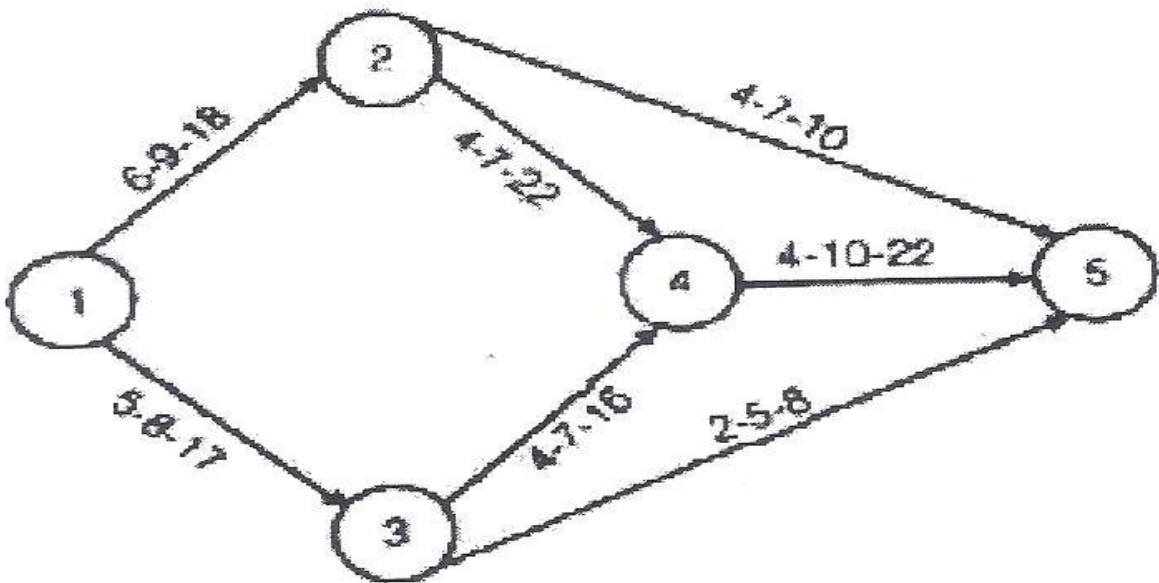
I_{yy} = 8.34×10^6 mm⁴

4. Design the RC floor slab for a room of internal dimensions of 4.0 m \times 9.5 m. Assume the slab to

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be simply supported on 230 mm thick masonry walls. The slab is to support live load of 4.0 kN/m^2 and surface finish of 1 kN/m^2 . Use M20 grade concrete. HYSD steel of Fe415 grade. Draw reinforcement details. 20

5. For the network shown, the estimated time in days for each activity is shown in the network diagram.



Determine the critical path. Also determine the probability of completing the work in 35 days. The

values of Z and corresponding probability are given in table. 20

Z	Probability
	(%)
1.0	84.13
1.1	86.43
1.2	88.90
1.5	93.92
2.0	97.92
3.0	99.87

6. A concrete strip footing rectangular in cross-section is located at ground level and extends 1.2 m below the

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ground level. It carries UDL of 15000 kg/m. The soil profile consists of homogeneous clay 6 m thick over laying rock. The clay properties are saturated unit bulk weight = 1750 kg/m³, Shear strength (undrained) = 8500 kg/m².

Compressibility = 1×10^{-4} m²/100 kg.

Determine :

- (i) Width of footing for F.O.S of F=2
- (ii) Ultimate consolidation settlement for F=2

Assume bulk unit weight of concrete = 2500 kg/m³

Neglect the spread of load beneath the footing and any side cohesion on the foundation. 20

7. (a) Define Slenderness ratio. Discuss the limitations of Euler's formula. 10

- (b) Two shafts A and B of the same material and of the same lengths are subjected to the same Torque. Shaft A is a solid circular section, while shaft B is a hollow circular section whose internal diameter is 0.7 times its outside diameter. If the maximum shear stress in each shaft is to be the same, compare the weights of the two shafts. 10
8. (a) What is Prestress ? Explain any *one* technique of prestressing. 10
- (b) A symmetrical two-hinged parabolic arch is of span 40 m and of central rise 6 m. It carries a single point load of 16 tonnes at a horizontal

distance of 15 m from the left hinge. If the Moment of Inertia of the cross-section of the arch varies as the secant of the slope of the arch axis, calculate, from first principle, the Horizontal Thrust in the arch.

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